Washington State Department of Transportation
and
Max J. Kuney Co./Malcolm Drilling, Inc.

Columbia River Crossing
Drilled Shaft & Driven Pile Test Program
I-5, MP 307.86 to MP 0.45
WSDOT Contract 8231

Dispute Review Board Recommendation Obstructions/Differing Site Conditions at Test Shaft BS-1

Hearing Date – March 8, 2013

Project Description

The Washington State Department of Transportation's (WSDOT) project description is as follows, "This Contract provides for the improvement of Interstate 5 Columbia River Bridge, MP OR 307.86 to WA 0.45, Columbia River Bridge Drilled Shaft and Driven Pile Test Program, by installing drilled shafts, drilled shaft testing, piles, pile testing and removing and/or cutting off piles and other work, all in accordance with the attached Contract Plans, these Contract Provisions, and the Standard Specifications."

The $4.22 MM project consists of three test shafts and five piles with instrumentation to measure the geotechnical properties of the soil and underlying Troutdale formation. Two of the test shafts (BS-1 and BS-2) and all of the piles were constructed in Oregon on Hayden Island. The third test shaft (CS-1) was constructed in Vancouver, WA near Columbia Street. The three test shafts range from 6' to 10' in diameter with either temporary or permanent casing ranging from 130' to 215' in length. The shaft depths range from 130' to 252'.

Background

On November 14, 2011 the Washington State Department of Transportation advertised Contract No. 8231 for bids. The contract provisions provide 82 working days for physical completion. After four addenda were issued, bids were received on December 14, 2011. Max J. Kuney Company (MJK) was the low of eight bidders at $4,220,000. The contract was awarded MJK on December 19, 2011 and was fully executed on January 9, 2012. MJK subsequently awarded a subcontract to Malcolm Drilling Co., Inc. (MDCI) for the shaft work that is at issue in this hearing.

Dispute

The issue presented to the Dispute Review Board (DRB) concerns the responsibility for extra costs incurred by Malcolm (primarily) and Kuney (secondarily) due to damage to the 10' diameter, 1-¼" wall permanent casing at test shaft BS-1.

The facts and arguments are detailed in position papers presented by Kuney/Malcolm and WSDOT on March 5, 2013, supplemented by a rebuttal paper from WSDOT on March 6, 2013 and by oral presentations at the hearing on March 8, 2013.

The question presented to the Dispute Review Board is as follows:

Given the [casing] damage and resulting costs incurred during the installation of the casing for Shaft BS-1, is the Contractor entitled to additional compensation?

If the answer is yes, what is the basis and general scope of the additional payment?

The DRB was asked for its recommendation regarding entitlement only, but asked to give a general scope of compensable costs if entitlement is found.

Dispute Review Board Hearing

The Contractor's claim and the State's rebuttal were orally presented to the Dispute Review Board (DRB) on March 8, 2013, at WSDOT's Corson Avenue Materials Lab Conference Room in Seattle, Washington. A copy of the attendance sign-in sheet is Attachment A.

The members of the Dispute Review Board are John Hunt, Chairman, Bill Ott and David Place.

Kuney/Malcolm's Position (Summary)

Malcolm asserts that the damage to the casing was caused by an obstruction (in their opinion most likely a "large boulder or multiple boulders nested with cobbles") and that the removal of the obstruction and repair to the casing is reimbursable under Bid Item 3, 0256 Removing Shaft Obstructions, Specification Sections 3.03(G) and 5.01(B).

Alternatively, Malcolm asserts that the damage was caused by a differing site condition ("a concentration of boulders") and is therefore payable under Section 1-04.7, Differing Site Conditions (Changed Conditions) of the Contract.

Exhibit 2 to Malcolm's presentation to the DRB is the July 18, 2012 opinion letter from Malcolm's consultant, Chris Breeds of SubTerra, Inc. Mr. Breeds' opinion is summarized as follows:

> *"In our opinion, the rounded boulder obstruction(s) encountered by MDCI at a depth of 215-ft (approx.) are responsible for the casing damage that occurred on May 21, 2012 at Shaft BS-1. Furthermore, MDCI adopted a cautious*

approach when selecting the casing thickness when they increased the thickness by 25% over that previously used for similar projects in similar and more difficult ground conditions."

WSDOT's Position (Summary)

The State's position[1] is that

- *"The casing, as originally installed, did not meet the requirements of Section 2.01.A of the Drilled Shafts Special Provision. This section requires the Contractor to provide a casing of ample strength for installation stresses and all pressures and forces acting on the casing. A casing that meets these requirements would not be damaged during installation. The Contractor is in control of selecting the thickness of the casing, thus, carrying the risk of damage to the permanent work for their decision.*
- *There is no differing site condition because the soil conditions encountered were the same as the conditions described in the Summary of Geotechnical Conditions and boring logs. Therefore, the damage to the casing is not attributable to unexpected soil conditions.*
- *There is no entitlement for payment under Section 5.01.B of the Drilled Shafts Special Provision because payment under this section is limited to the effort and delay to remove, break-up, or push aside an obstruction."*
- The State also argued verbally that the Contractor is required to repair damage to the permanent casing as required under ¶1-07.13 as it is repair to the permanent work.

Specifications

The DRB finds (as do the parties) that the relevant specification sections are as noted below. The full text of these specifications is included in Attachment B.

1. From the 2010 Standard Specifications, as amended by the Special Provisions

- Specification Section 1-04.7, Differing Site Conditions (Changed Conditions)
- Specification Section 1-07.13, Contractor's Responsibility for the Work

2. From the 2012 Standard Specifications, as amended by the Special Provisions

- Specification Section 6-19.3(3)E[2]

[1] See WSDOT's hearing position paper.
[2] The 2012 Standards do not apply to this contract but are noted here because the State cited this paragraph in its presentation.

3. From the Special Provisions for the Construction of 1-5 Columbia River Crossing, Drilled Shaft and Driven Pile Test Program, 11X316, Clark County, WA; Multnomah County, OR

- Special Provision Supplementing ¶1-02.4, Bid Procedures and Conditions: Examination of Plans, Specifications and Site of Work: Subsurface Information
- Special Provision Supplementing ¶6-01.2, Structures: General Requirements for Structures: Foundation Data
- Special Provision 2.01.A, Drilled Shafts: Materials: Casing
- Special Provision 2.01.E, Drilled Shafts: Materials: Casing
- Special Provision 3.02.B, Drilled Shafts: Construction Requirements: Submittals: Drilled Shaft Installation Plan
- Special Provision 3.03.B, Drilled Shafts: Construction Requirements: Drilled Shaft Excavation: Furnish and Install Casing
- Special Provision 3.04.G, Drilled Shafts: Construction Requirements: Drilled Shaft Excavation: Obstructions
- Special Provision 5.01.B, Drilled Shafts: Payment: Payment for Removing Drilled Shaft Obstructions[3]
- Special Provision 6.01.9, Drilled Shafts: Submittals: Drilled Shaft Excavation Plan
- Special Provision Appendix A, Log of Test Borings, Page 1 through Page 12
- Special Provision Appendix B, Summary of Geotechnical Conditions, Page 1 through Page 1.***

DRB Discussion

In our view this dispute turns on whether or not the damage to the permanent casing was caused by an obstruction. Malcolm and its consultant offer a very plausible scenario of how the casing was severely damaged by a "large boulder or multiple boulders nested with cobbles". (See Attachment C for a picture of the damaged casing.) The State offers no explanation for how the damage occurred but simply argues that the 1-¼"-wall casing was not heavy enough; it offers no explanation of the mechanics of how the exceptional damage to the casing occurred if no obstruction was present. The DRB can not find a plausible alternative explanation to that offered by Malcolm, and we believe it is far more likely than not that the casing encountered an obstruction and was damaged.

The question for the DRB then becomes whether or not the "obstruction" provisions of the contract apply, and if so, what types of costs are recoverable. The clauses in question are found in the Special Provisions, ¶3.03G and ¶5.01.B, as follows:

"3.03.G. When obstructions are encountered, the Contractor shall notify the Engineer promptly. An obstruction is defined as a specific object (including, but not limited to,

[3] The DRB notes that WSDOT cites ¶6-19.3(3)E, which is this same paragraph but is found in the 2012 Standard Specifications. The DRB also notes that the 2012 spec deletes the term "drilled" shaft and refers to the work only as a "shaft."

boulders, logs, and man made objects) encountered during the drilled shaft excavation operation which prevents or hinders the advance of the drilled shaft excavation. When efforts to advance past the obstruction to the design drilled shaft tip elevation result in the rate of advance of the drilled shaft drilling equipment being significantly reduced relative to the rate of advance for the portion of the drilled shaft excavation in the geological unit that contains the obstruction, then the Contractor shall remove, break-up, or push aside, the obstruction under the provisions of subsection 5.01.B of this Special Provision. The method of dealing with such obstructions, and the continuation of excavation shall be as proposed by the Contractor and approved by the Engineer."

"5.01.B. Payment for Removing Drilled Shaft Obstructions

1. *Payment for removing, breaking-up, or pushing aside, drilled shaft obstructions, as defined in subsection 3.03.G of this Special Provision, will be made for the changes in drilled shaft construction methods necessary to deal with the obstruction. The Contractor and the Engineer shall evaluate the effort made and reach agreement on the equipment and employees utilized, and the number of hours involved for each. Once these cost items and their duration have been agreed upon, the payment amount will be determined using the rate and markup methods specified in Section 1-09.6. For the purpose of providing a common proposal for all bidders, the Contracting Agency has entered an amount for the item "Removing Shaft Obstructions" in the bid proposal to become a part of the total bid by the Contractor.*

2. *If drilled shaft construction equipment is idled as a result of the work required to deal with the obstruction and cannot be reasonably reassigned within the project, then standby payment for the idled equipment will be added to the payment calculations. If labor is idled as a result of the work required to deal with the obstruction and cannot be reasonably reassigned within the project, than all labor costs resulting from Contractor labor agreements and established Contractor policies will be added to the payment calculations.*

3. *The Contractor shall perform the amount of obstruction work estimated by the Contracting Agency within the original time of the contract. The Engineer will consider a time adjustment and additional compensation for costs related to the extended duration of the drilled shaft construction operations, provided:*

   a. *the dollar amount estimated by the Contracting Agency has been exceeded, and*

   b. *the Contractor shows that the obstruction removal work represents a delay to the completion of the project based on the current progress schedule provided in accordance with Section 1-08.3."*

The DRB has concluded that the specific damage to the cutting head of the oscillator could only be caused by an obstruction and thus the Contractor encountered an obstruction that not only slowed his "rate of production" but in fact stopped it completely. Further, the Contractor then went on to "remove, break-up or push aside the obstruction". The

Contractor's "method of dealing with such obstruction" was "proposed by the Contractor[4]" and although the State contends it did not "approve" the plan, the DRB finds that the State did approve the plan when it stated, "We believe that MDCI's proposal to remove, repair, and reinstall the casing at Shaft BS-1 is a viable proposal, and should be pursued to meet the contract requirements.[5]"

Malcolm executed its proposed plan and now seeks reimbursement under ¶5.01.B. The State demurs for two reasons:

1. First, the State argues that (1) ¶2.01.A. of the Special Provisions requires the Contractor to supply "permanent casing . . . of ample strength to resist damage and deformation from . . . installation stresses and all pressures and forces acting on the casing" and that the damage to the casing is de facto proof that the Contractor did not comply. The DRB rejects this argument and has the opinion that the 1.25 inch permanent casing for this shaft was of ample strength to resist any deformation without an obstruction being present

2. Second, the State argues that to be paid for obstruction removal under ¶5.01.B the Contractor must "change his construction methods" and did not do so. "The Contractor used a thicker cutting shoe and a slower rate of advancement to perform the same construction method as [planned]." In fact, the DRB concludes that the Contractor did change its method of construction when it removed the permanent casing, backfilled the shaft with pea gravel, modified its equipment and re-"drilled" the shaft using polymer lubrication..

Because we believe Malcolm's added cost of dealing with the obstruction is reimbursable under the shaft obstruction provisions of the contract, we have not addressed the differing site condition argument above. We will do so here.

The applicable specification section is

> ***"1-04.7 Differing Site Conditions (Changed Conditions)***
>
> *During the progress of the Work,* ***if preexisting subsurface or latent physical conditions are encountered at the site, differing materially from those indicated in the Contract, or if preexisting unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the Work provided for in the Contract****, are encountered at the site, the party discovering such conditions shall promptly notify the other party in writing of the specific differing site conditions before they are disturbed and before the affected Work is performed.*
>
> *Upon written notification, the Engineer will investigate the conditions and* ***if*** *he/she determines that* ***the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any Work under the Contract, an adjustment, excluding loss***

[4] MJK Serial letter 15 of May 23, 2012 transmitting MDCI Serial Letter 1 of the same date (WSDOT Ex. F).
[5] WSDOT Serial Letter No. 70 of May 23, 2012 (WSDOT Ex. G).

of anticipated profits, will be made and the Contract modified in writing accordingly*. The Engineer will notify the Contractor of his/her determination whether or not an adjustment of the Contract is warranted."* [Emphasis added.]

Malcolm argues that the "concentrated boulders" were a differing site condition as defined in Specification Section 1-04.7 and therefore its extra costs are reimbursable under that contract provision. It points out that (1) there was "no mention of boulders within the entire length of the bore log[6]" [CRC-HI-006]; (2) the Shannon & Wilson, Inc. Summary of Geotechnical Conditions noted that in the Gravel Alluvium deposit "the presence of boulders is possible[7];" and (3) that "when the borings (showing no boulders) are read together with the narrative Summary of Geotechnical Conditions, they indicate no more that a high probability of encountering 'occasional boulders.' Concentrated boulders were a differing site condition, and they substantially impacted Malcolm's work."[8]

The State argues that "the rocks encountered were neither unusual nor unexpected. The soil conditions encountered in Shaft BS-1 were consistent with the soil conditions described in the Contract; specifically the Summary of Geotechnical Conditions and the bore logs. Therefore, there is not a differing site condition[9]."

The Summary of Geotechnical Conditions states "the probability of encountering boulders is relatively high[10]." We must certainly conclude that encountering single boulders during shaft construction would not be a differing site condition. We believe a "nest" or "concentration" of boulders would not be expected by a reasonable bidder.

In the end, however, this entitlement argument, unlike that of the obstruction clause, turns on what was ***actually*** encountered. While we think it more likely than not that the damage to the casing was caused by nested boulders, neither we nor anyone else can be certain that what Malcolm's casing encountered was "concentrated boulders," and in fact even Malcolm is not sure since it opines that the damage was caused by a "large boulder or multiple boulders nested with cobbles."

DRB Recommendation

For all of the reasons cited above, the DRB unanimously recommends that under the obstruction specification Kuney/Malcolm is entitled to additional compensation for the casing damage and resulting added costs incurred during the installation of the casing for Shaft BS-1.

The contractual basis for this recommendation is that the DRB considers the work to be compensable under Special Provision 3.04.G, Drilled Shafts: Construction Requirements: Drilled Shaft Excavation: Obstructions and under Special Provision 5.01.B, Drilled Shafts: Payment: Payment for Removing Drilled Shaft Obstructions.

[6] Malcolm PowerPoint slide number 19.
[7] Malcolm PowerPoint slide number 20.
[8] Malcolm PowerPoint slide number 23.
[9] WSDOT Rebuttal Paper, page 1.
[10] Summary of Geotechnical Conditions, page 3.

The general scope of the additional compensation includes the following cost categories:

1. Casing removal, back-filling the shaft, casing and equipment repair, cutting shoe replacement, and re-drilling of the shaft and spoil disposal.
2. Equipment standby during the compensable delay
3. Time-related site overhead costs during the compensable delay

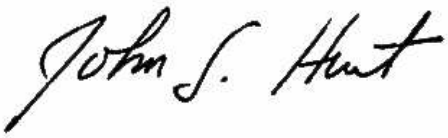
The following categories of cost would not be compensable:

1. Consultant costs
2. Claim preparation costs
3. Normal equipment repair costs
4. Grab cable repair costs
5. Trunnion repair costs

The Contractor is also entitled to a compensable time extension for the time spent removing the shaft obstructions. The time extension due is commensurate with the time spent during the expenditures in the reimbursable cost categories above.

This Dispute Review Board's recommendation is unanimous.

Respectfully submitted:



	3/22/13
John S. Hunt, Chairman	Date

	3/22/13
William P. Ott	Date

	3/22/13
David Place	Date

ATTACHMENT A

WSDOT/Kuney/Malcolm
Columbia River Crossing Drilled Shaft & Driven Pile Test Program
Contract 8231

Attendees - DRB Hearing Re: Test Shaft BS-1 Obstructions/Differing Site Conditions
Friday, March 08, 2013

Print Name	Initital	Affiliation
John Hunt		DRB
Bill Ott		DRB
Dave Place		DRB
Stuart Bennion		WSDOT
Chris Breeds		Sub Terra
Dave Erickson		WSDOT
Frank Green		WSDOT
Tait McCutchan		Malcolm Drilling
Craig McDaniel		WSDOT
Al Rasband		Malcolm Drilling
Rodney Rodriguez		WSDOT
John Roe		Malcolm Drilling
Ken Stockett		WSDOT
Greg Waugh		Max J. Kuney
Mike Niemi		WSDOT
William Hrg		WSDOT
Lynn Rust		WSDOT

1-04.7 Differing Site Conditions (Changed Conditions)

During the progress of the Work, if preexisting subsurface or latent physical conditions are encountered at the site, differing materially from those indicated in the Contract, or if preexisting unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the Work provided for in the Contract, are encountered at the site, the party discovering such conditions shall promptly notify the other party in writing of the specific differing site conditions before they are disturbed and before the affected Work is performed.

Upon written notification, the Engineer will investigate the conditions and if he/she determines that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any Work under the Contract, an adjustment, excluding loss of anticipated profits, will be made and the Contract modified in writing accordingly. The Engineer will notify the Contractor of his/her determination whether or not an adjustment of the Contract is warranted.

No Contract adjustment which results in a benefit to the Contractor will be allowed unless the Contractor has provided the required written notice.

The equitable adjustment will be by agreement with the Contractor. However, if the parties are unable to agree, the Engineer will determine the amount of the equitable adjustment in accordance with Section 1-09.4. Extensions of time will be evaluated in accordance with Section 1-08.8.

If the Engineer determines that different site conditions do not exist and no adjustment in costs or time is warranted, such determination shall be final as provided in Section 1-05.1.

If there is a decrease in the costs or time required to perform the Work, failure of the Contractor to notify the Engineer of the differing site conditions shall not affect the Contracting Agency's right to make an adjustment in the costs or time.

No claim by the Contractor shall be allowed unless the Contractor has followed the procedures provided in Section 1-04.5 and 1-09.11.

1-04.8 Progress Estimates and Payments

Engineer-issued progress estimates or payments for any part of the Work shall not be used as evidence of performance or quantities. Progress estimates serve only as basis for partial payments. The Engineer may revise progress estimates any time before final acceptance. If the Engineer deems it proper to do so, changes may be made in progress estimates and in the final estimate.

1-04.9 Use of Buildings or Structures

The Engineer will decide whether any building or Structure on the Right of Way may remain during the Work and whether the Contractor may use such a building or Structure.

f. Plots of creep displacement for each loading direction and increment.

g. Plot of equivalent top-of-drilled shaft displacement for the test drilled shaft, developed from the load test data.

Measurement

4.01 Measurement

Drilled Shaft Osterberg Cell (O-cell) Load Test will be measured per each drilled shaft tested.

Payment

5.01 Payment will be made in accordance with the Standard Specifications Section 1-04.1 for the following bid items:

"Drilled Shaft Osterberg Cell (O-cell) Load Test", per each.

(******)

DRILLED SHAFTS

Description

1.01 Drilled Shafts

A. This item of work shall consist of furnishing all materials, labor, tools, equipment, services and incidentals necessary to construct the drilled shafts in accordance with the Plans, the Standard Specifications, and the Special Provisions.

Materials

2.01 Casing

A. All permanent casing shall be of steel base metal conforming to ASTM A 36. All permanent casing shall be of ample strength to resist damage and deformation from transportation and handling, installation stresses, and all pressures and forces acting on the casing.

All temporary casing shall be a smooth wall structure of steel base metal, except where corrugated metal pipe is shown in the Plans as an acceptable alternative material. All temporary casing shall be of ample strength to resist damage and deformation from transportation and handling, installation and extraction stresses, and all pressures and forces acting on the casing. The casing shall be capable of being removed without deforming and causing damage to the completed drilled shaft, and without disturbing the surrounding soil.

B. Permanent casing is defined as casing designed as part of the drilled shaft structure and installed to remain in place after construction is complete. Temporary casing is defined as casing installed to facilitate drilled shaft construction only, which is not designed as part of the drilled shaft structure, and which shall be completely removed after drilled shaft construction is complete, unless otherwise shown in the Plans.

C. The casing shall be watertight and clean prior to placement in the excavation.

D. The outside diameter of the casing shall not be less than the specified diameter of the drilled shaft. The inside diameter of the casing shall not be greater than the specified diameter of the drilled shaft plus six inches, except as otherwise noted for drilled shafts 5'-0" or less in diameter, and as otherwise noted in subsection 3.03.C of this Special Provision for temporary telescoping casing. The inside diameter of casings for drilled shafts 5'-0" or less in diameter shall not be greater than the specified diameter of the drilled shaft plus 1'-0".

E. Where the minimum thickness of the casing is specified in the Plans, it is specified to satisfy structural design requirements only. The Contractor shall increase the casing thickness as necessary to satisfy the requirements of item A of this section.

2.02 Reinforcing Steel

A. Reinforcing steel used in the construction of drilled shafts shall conform to Section 9-07.

B. Steel reinforcing bar centralizers shall be steel, conforming to the details shown in the Plans. The Contractor may propose the use of alternative steel reinforcing bar devices as part of item 7 of the drilled shaft installation plan submittal, as specified in subsection 3.02.B of this Special Provision, subject to the Engineer's review and approval of such devices.

2.03 Concrete

A. Concrete used in the construction of drilled shafts shall be Class 4000P conforming to Section 6-02.

B. When drilled shafts are constructed in water, the concrete used for the casing shoring seal shall be Class 4000W conforming to Section 6-02.

2.04 Slurry

Slurry shall conform to one of the following:

A. Mineral Slurry shall not be allowed.

B. Synthetic Slurries

1. Synthetic slurries shall be used in conformance with the manufacturer's recommendations, the quality control plan specified in subsection 3.02.B.4 of this Special Provision, and these Special Provisions. The following synthetic slurries are approved as slurry systems, with additives that have been load tested for the California Department of Transportation:

ATTACHMENT B

Product	Manufacturer
ShorePac GCV	CETCO 1500 West Shure Drive Arlington Heights IL, 60004
SlurryPro CDP	KB International, LLC Suite 216, 735 Broad Street Chattanooga, TN 37402-1855

Other synthetic slurry products may be approved for use provided the product meets the acceptance criteria established by WSDOT, including status as an approved synthetic slurry (with load tested additives) with the California Department of Transportation (Caltrans).

2. The sand content of synthetic slurry prior to final cleaning and immediately prior to placing concrete shall be less than 2.0 percent, in accordance with API 13B-1, Section 5.

C. Water Slurry (with or without site soils)

1. Water with or without site soils may be used as slurry when casing is used for the entire length of the drilled hole. Use of water slurry without full length casing may only be used with the approval of the Engineer.

2. Water slurry shall conform to the following requirements:

Property	Test	Requirement
Density (pcf)	Mud Weight (Density) API 13B-1, Section 1	65 max.
Sand Content (percent)	Sand API 13B-1, Section 5	1.0 max.

Use of water slurry in salt water installations will not be allowed.

Slurry temperature shall be at least 40F when tested.

2.05 Access Tubes for Crosshole Sonic Log Testing

A. Access tubes for crosshole sonic log testing shall be steel pipe of 0.145 inches minimum wall thickness and at least 1-1/2 inch inside diameter.

B. The access tubes shall have a round, regular inside diameter free of defects and obstructions, including all pipe joints, in order to permit the free, unobstructed passage of 1.3 inch maximum diameter source and receiver probes used for the crosshole sonic log tests. The access tubes shall be watertight, free from corrosion with clean internal and external faces to ensure good bond between the concrete and the access tubes. The access tubes shall be fitted with watertight threaded

PVC caps on the bottom, and shall be fitted with watertight PVC caps, secured in position by means as approved by the Engineer, on the top.

2.06 Grout

A. Grout for filling the access tubes at the completion of the crosshole sonic log tests shall be a neat cement grout conforming to Section 9-20.3 with a maximum water/cement ratio of 0.45.

Construction Requirements

3.01 Quality Assurance

A. Drilled Shaft Construction Tolerances

1. Drilled Shafts shall be constructed so that the center at the top of the drilled shaft is within the following horizontal tolerances:

Drilled Shaft Diameter	Tolerance
Less than or equal to 2'-0"	3"
Greater than 2'-0" and less than 5'-0"	4"
5'-0" or larger	6"

2. Drilled Shafts shall be within 1.5 percent of plumb. For rock excavation, allowable tolerance can be increased to 2 percent max.

3. During drilling or excavation of the drilled shaft, the Contractor shall make frequent checks on the plumbness, alignment, and dimensions of the drilled shaft. Any deviation exceeding the allowable tolerances shall be corrected with a procedure approved by the Engineer.

4. Drilled shaft steel reinforcing bar placement tolerances shall conform to Section 6-02.3(24)C.

B. Nondestructive Testing of Drilled Shafts

1. Unless otherwise specified in this Special Provision, the Contracting Agency will perform crosshole sonic log testing of specific drilled shafts, except for those constructed completely in the dry, selected in accordance with subsection 3.09.A of this Special Provision. The Contractor shall accommodate the crosshole sonic log testing by furnishing and installing access tubes in accordance with subsection 3.06.A of this Special Provision.

2. Thermal Integrity Testing shall be performed by the Contractor on each shaft installed.

C. Drilled Shaft Preconstruction Conference

1. A drilled shaft preconstruction conference shall be held at least five working days prior to the Contractor beginning any drilled shaft construction work at the site to discuss construction procedures, personnel, and equipment to be used,

and other elements of the approved drilled shaft installation plan as specified in subsection 3.02.B of this Special Provision. Those attending shall include:

a. (representing the Contractor) The superintendent, on site supervisors, and all foremen in charge of excavating the drilled shaft, placing the casing and slurry as applicable, placing the steel reinforcing bars, and placing the concrete, a representative from Loadtest, Inc. and a representative of the Thermal Integrity Testing subcontractor. If synthetic slurry is used to construct the drilled shafts, the slurry manufacturer's representative or approved Contractor employees trained in the use of the synthetic slurry shall also attend.

b. (representing the Contracting Agency) The Project Engineer, key inspection personnel, representatives from the WSDOT Construction Office and Materials Laboratory Geotechnical Branch, representatives from ODOT, and the geotechnical engineer who will be onsite during the test drilled shaft construction and load testing.

2. If the Contractor proposes a significant revision of the approved drilled shaft installation plan, as determined by the Engineer, an additional conference shall be held before any additional drilled shaft construction operations are performed.

3.02 Submittals

A. Construction Experience

1. Prior to the start of drilled shaft construction, the Contractor shall electronically submit a project reference list to the Engineer for approval verifying the successful completion by the Contractor of at least three separate foundation projects with drilled shafts of diameters similar to or larger than those shown in the Plans to depths not less than 100 feet, and ground conditions similar to those identified in the Contract. A brief description of each listed project shall be provided along with the name and current phone number of the project owner or the owner's Contractor.

2. Prior to the start of drilled shaft construction, the Contractor shall electronically submit a list identifying the on-site supervisors, and drill rig operators potentially assigned to the project to the Engineer for approval. The list shall contain a brief description of each individual's experience in drilled shaft excavation operations, and placement of assembled steel reinforcing bar cages and concrete in drilled shafts. The individual experience lists shall be limited to a single page for each supervisor or operator.

a. On-site supervisors shall have a minimum two years experience in supervising construction of drilled shaft foundations of similar size diameter to those shown in the Plans to depths not less than 100 feet and similar geotechnical conditions to those described in the boring logs and summary of geotechnical conditions. The work experience shall be direct supervisory responsibility for the on-site drilled shaft construction operations. Project management level positions

indirectly supervising on-site drilled shaft construction operations is not acceptable for this experience requirement.

b. Excavation drill rig operators shall have a minimum one year experience in construction of drilled shaft foundations.

c. On-site supervisors shall have experience with the instrumentation and completion of at least one successful drilled shaft load test.

3. The Engineer will approve or reject the Contractor's qualifications and field personnel within 10 working days after receipt of the submission. Work shall not be started on any drilled shaft until the Contractor's qualifications and field personnel are approved by the Engineer. The Engineer may suspend the drilled shaft construction if the Contractor substitutes unapproved personnel. The Contractor shall be fully liable for the additional costs resulting from the suspension of work and no adjustments in contract time resulting from the suspension of work will be allowed.

B. Drilled Shaft Installation Plan

The Contractor shall electronically submit, in pdf format, a drilled shaft installation narrative for approval by the Engineer. In preparing the narrative, the Contractor shall reference the available subsurface data provided in the contract test hole boring logs, the Summary of Geotechnical Conditions provided in the Appendix to the Special Provisions, and the geotechnical data report(s) prepared for this project. This narrative shall provide at least the following information:

1. Proposed overall construction operation sequence.

2. Description, size and capacities of proposed equipment, including but not limited to cranes, drills, augers, bailing buckets, final cleaning equipment and drilling unit. The narrative shall describe why the equipment was selected, and describe equipment suitability to the anticipated site conditions, depths, and work methods. The narrative shall include a project history of the drilling equipment demonstrating the successful use of the equipment on drilled shaft diameters of equal or greater size in similar soil/rock conditions. The narrative shall include details of drilled shaft excavation methods and disposal of spoils. The narrative shall also include details of measures to be taken to cover the shaft and protect all instrumentation and cables when active work is not occurring on the drilled shaft.

3. Details of the method(s) to be used to ensure drilled shaft stability (i.e., prevention of caving, bottom heave, temporary stability of reinforcing, etc. using temporary casing, slurry, or other means) during excavation (including pauses and stoppages during excavation) and concrete placement. If permanent casings are required, casing dimensions and detailed procedures for installation shall be provided.

4. Details of the method(s) to be used for bottom cleanout shall be provided. Details shall include specific equipment and procedures, including sequencing with drilled shaft excavation, reinforcing cage placement and

temporary stability, and concrete placement. The narrative shall provide the resulting thickness of loose material/sediment at the base of the drilled shaft as a result of the proposed method(s).

5. Detailed procedures for mixing, using and maintaining the slurry shall be provided. A detailed mix design (including all additives and their specific purpose in the slurry mix), and a discussion of its suitability to the anticipated subsurface conditions, shall also be provided for the proposed slurry.

   The submittal shall include a detailed plan for quality control of the selected slurry, including tests to be performed, test methods to be used, and minimum and/or maximum property requirements which must be met to ensure that the slurry functions as intended, considering the anticipated subsurface conditions and drilled shaft construction methods, in accordance with the slurry manufacturer's recommendations and these Special Provisions. As a minimum, the slurry quality control plan shall include the following tests:

Property	Test Method
Density	Mud Weight (Density), API 13B-1, Section 1
Viscosity	Marsh Funnel and Cup, API 13B-1, Section 2.2
PH	Glass Electrode, pH Meter, or pH Paper
Sand Content	Sand, API 13B-1, Section 5

6. Details of concrete placement, including proposed operational procedures for pumping methods, and a sample uniform yield form to be used by the Contractor for plotting the approximate volume of concrete placed versus the depth of drilled shaft for all drilled shaft concrete placement (except concrete placement in the dry).

7. When drilled shafts are constructed in water, the submittal shall include seal thickness calculations, seal placement procedure, and descriptions of provisions for casing shoring dewatering and flooding.

8. Description and details of the storage and disposal plan for excavated material, and drilling slurry (if applicable).

9. Reinforcing steel shop drawings, details of reinforcement placement, including bracing, centering, and lifting methods, and the method to assure the reinforcing cage position is maintained during construction, including use of bar boots and/or rebar cage base plates, and instrumentation.

The reinforcing steel assembly and installation plan shall include:

a. Procedure and sequence of steel reinforcing bar cage assembly.

b. The tie pattern, tie types and tie wire gages for all ties on permanent reinforcing and temporary bracing.

c. Number and location of primary handling steel reinforcing bars used during lifting operations.

d. Type and location of all steel reinforcing bar splices.

e. Details and orientation of all internal cross-bracing, including a description of connections to the steel reinforcing bar cage.

f. Description of how temporary bracing is to be removed.

g. Location of support points during transportation.

h. Cage weight and location of the center of gravity.

i. Number and location of pick points used for lifting for installation, and for transport (if assembled off-site).

j. Crane charts and a description and/or catalog cut sheets for all spreaders, blocks, sheaves and chokers used to equalize or control lifting loads.

k. The sequence and minimum inclination angle at which intermediate belly rigging lines (if used) are released.

l. Pick point loads at 0, 45, 60 and 90 degrees and at all intermediate stages of inclination where rigging lines are engaged or slackened.

m. Methods and temporary supports required for cage splicing.

n. For picks involving multiple cranes, the relative locations of the boom tips at various stages of lifting, along with corresponding net horizontal forces imposed on each crane.

For shafts with a 6'-0" minimum nominal diameter and/or drilled shafts with 60'-0" minimum length, the reinforcing steel assembly and installation plan shall be prepared and submitted in accordance with Section 6-01.9.

The Engineer will evaluate the drilled shaft installation plan for conformance with the Plans, Specifications and Special Provisions, within the review time specified in Section 6-01.9. A Drilled Shaft Installation Plan Submittal Teleconference Meeting will be scheduled by the Contracting Agency following review of the Contractor's initial submittal of the plan and prior to Contracting Agency formal response to the initial submittal. Teleconference participants shall include the following:

a. (representing the Contractor) The superintendent, on-site supervisors, and other Contractor personnel involved in the preparation of the drilled shaft installation plan including a representative from Loadtest, Inc. and a representative of the Thermal Integrity Testing subcontractor.

b. (representing the Contracting Agency) The Project Engineer, key inspection personnel, representatives from the Materials Laboratory Geotechnical Branch, the WSDOT Construction Office, representatives from ODOT and the Geotechnical Engineer who will be onsite during the test drilled shaft construction and load testing.

C. Slurry Technical Assistance

1. If slurry other than water slurry is used to construct the drilled shafts, the Contractor shall provide or arrange for technical assistance in the use of the slurry as specified in subsection 3.04.A.1 of this Special Provision. The Contractor shall electronically submit the following to the Engineer:

a. The name and current phone number of the slurry manufacturer's technical representative assigned to the project, and the frequency of scheduled visits to the project site by the synthetic slurry manufacturer's representative.

b. The name(s) of the Contractor's personnel assigned to the project and trained by the slurry manufacturer in the proper use of the slurry. The submittal shall include a signed training certification letter from the slurry manufacturer for each trained Contractor's employee listed, including the date of the training.

D. Crosshole Sonic Log Testing Organization and Personnel

1. At least seven calendar days prior to beginning drilled shaft construction, the Contractor shall submit the name of the independent testing organization, and the names of the personnel, conducting the crosshole sonic log tests to the Engineer for approval. The submittal shall include documentation that the qualifications specified below are satisfied. The independent testing organization and the testing personnel shall meet the following minimum qualifications:

a. The testing organization shall have performed crosshole sonic log tests on a minimum of three deep foundation projects in the last two years.
b. Personnel conducting the tests for the testing organization shall have a minimum of one year experience in crosshole sonic log testing and interpretation.

E. All submittals shall be in electronic pdf format, and all documents in each pdf shall be legible. All submittals shall be prepared jointly by the Contractor and any subcontractors that will be performing the work.

F. Work shall not begin until all the required submittals have been approved in writing by the Engineer. All procedural approvals given by the Engineer will be subject to

trial in the field and shall not relieve the Contractor of the responsibility to satisfactorily complete the work.

3.03 Drilled Shaft Excavation

A. Drilled shafts shall be excavated to the required depth as shown in the Plans. Drilled shaft excavation operations shall conform to this Special Provision and the drilled shaft installation plan as approved by the Engineer, except as otherwise specified by the Engineer. Once the excavation operation has been started, the excavation shall be conducted in a continuous operation until the excavation of the drilled shaft is completed, except for pauses and stops as noted, using approved equipment capable of excavating through the type of material expected. Pauses during this excavation operation, except for casing splicing, tooling changes, slurry maintenance, and removal of obstructions, are not allowed.

Pauses, defined as momentary interruptions of the excavation operation, will be allowed only for casing splicing, tooling changes, slurry maintenance, and removal of obstructions. Drilled shaft excavation operation interruptions not conforming to this definition shall be considered stops. Stops for uncased excavations (including partially cased excavations) shall not exceed 16 hours duration. Stops for fully cased excavations, excavations in rock, and excavations with casing seated into rock, shall not exceed 65 hours duration.

For stops exceeding the time durations specified above, the Contractor shall stabilize the excavation using one or both of the following methods:

1. For an uncased excavation, before the end of the work day, install casing in the hole to the depth of the excavation. The outside diameter of the casing shall not be smaller than six inches less than either the Plan diameter of the drilled shaft or the actual excavated diameter of the hole, whichever is greater. Prior to removing the casing and resumption of drilled shaft excavation, the annular space between the casing and the excavation shall be sounded. If the sounding operation indicates that caving has occurred, the casing shall not be removed and drilled shaft excavation shall not resume until the Contractor has stabilized the excavation in accordance with the drilled shaft installation plan conforming to subsection 3.02.B.3 of this Special Provision.

2. For both a cased and uncased excavation, backfill the hole with either CDF or granular material. The Contractor shall backfill the hole to the ground surface, if the excavation is not cased, or to a minimum of five feet above the bottom of casing (temporary or permanent), if the excavation is cased. Backfilling of drilled shafts with casing fully seated into rock, as determined by the Engineer, will not be required.

During stops, the Contractor shall stabilize the drilled shaft excavation to prevent bottom heave, caving, head loss, and loss of ground. The Contractor bears full responsibility for selection and execution of the method(s) of stabilizing and maintaining the drilled shaft excavation, in accordance with Section 1-07.13. Drilled shaft stabilization shall conform to the drilled shaft installation plan in accordance with subsection 3.02.B.3 of this Special Provision.

If slurry is present in the drilled shaft excavation, the Contractor shall conform to the requirements of subsection 3.04.B of this Special Provision regarding the maintenance of the slurry and the minimum level of drilling slurry throughout the stoppage of the drilled shaft excavation operation, and shall recondition the slurry to the required slurry properties in accordance with subsection 3.04 of this Special Provision prior to recommencing drilled shaft excavation operations.

B. The Contractor shall furnish and install casings as follows:

Wall Name or Bridge No.	Wall Station or Bridge Pier Number	Casing Type	Elev. Of Bottom of Required Casing (ft)	Upper And Lower Elevation Limits for Concurrent Casing Placement with Excavation
Test Loc. B	BS-1	Permanent	-189	26, -189
Test Loc. B	BS-2	Temporary	-94	6, -94
Test Loc. C	CS-1	Temporary	-101	26, -101

When installing required temporary or required permanent casings between the upper and lower elevation limits specified above, the casing shall be advanced prior to or concurrently with the excavation. Excavation in advance of the casing tip shall not be allowed. In no case shall drilled shaft excavation and casing placement extend below the bottom of drilled shaft excavation as shown in the Plans. Impact driving of drilled shaft casing is not permitted.

To maintain stable excavations and to facilitate construction, the Contractor may furnish and install temporary casing in addition to the required casing specified above. The Contractor shall provide temporary casing at the site in sufficient quantities to meet the needs of the anticipated construction method.

C. Where the acceleration coefficient used for seismic design of the structure, as specified in the General Notes of the structure Plans, is less than or equal to 0.16, the Contractor may use temporary telescoping casing for the drilled shafts at any bridge intermediate or interior pier, subject to the following conditions:

1. The Contractor shall submit the request to use temporary telescoping casing to the Engineer for approval. The request shall specify the diameters of the temporary telescoping casing, and shall specify the drilled shafts where use is requested. The Contractor shall not proceed with the use of temporary telescoping casing until receiving the Engineer's approval.

2. The minimum diameter of the drilled shaft shall be as shown in the Plans.

3. The temporary telescoping casing shall conform to subsections 2.01.A, 2.01.B, 2.01.C, and 2.01.E of this Special Provision.

4. Telescoping casing shall not be allowed for test drilled shafts.

D. The Contractor shall conduct casing installation and removal operations and drilled shaft excavation operations such that the adjacent soil outside the casing and drilled shaft excavation for the full height of the drilled shaft is not disturbed. Disturbed soil is defined as soil whose geotechnical properties have been changed from those of the original in-situ soil, and whose altered condition adversely affects the structural integrity of the drilled shaft foundation.

E. The Contractor shall use appropriate means such as a cleanout bucket, smooth mouth grab, or air lift to clean the bottom of the excavation of all drilled shafts. No more than 2 inches of loose or disturbed material shall be present at the bottom of the drilled shaft just prior to placing concrete.

F. The excavated drilled shaft shall be inspected and approved by the Engineer prior to proceeding with construction. The bottom of the excavated drilled shaft shall be sounded, by the Contractor, with a tape with a heavy weight attached to the end of the tape, or other means acceptable to the Engineer.

The Contractor shall use the Drilled Shaft Inspection Device (SID) to take sediment measurements and observe the bottom condition of the drilled shaft excavation at a minimum of five locations selected by the Engineer. The SID is a remotely operated camera capable of observing bottom conditions and measuring sediment under water and slurry. The Contractor shall provide the SID and the personnel to operate the device. SID inspections are required until the cleanliness of the drilled shaft excavation bottom is in accordance with subsection 3.03.E, The Contractor shall remove all cleaning and drilling equipment from the drilled shaft excavation during any SID inspection.

G. When obstructions are encountered, the Contractor shall notify the Engineer promptly. An obstruction is defined as a specific object (including, but not limited to, boulders, logs, and man made objects) encountered during the drilled shaft excavation operation which prevents or hinders the advance of the drilled shaft excavation. When efforts to advance past the obstruction to the design drilled shaft tip elevation result in the rate of advance of the drilled shaft drilling equipment being significantly reduced relative to the rate of advance for the portion of the drilled shaft excavation in the geological unit that contains the obstruction, then the Contractor shall remove, break-up, or push aside, the obstruction under the provisions of subsection 5.01.B of this Special Provision. The method of dealing with such obstructions, and the continuation of excavation shall be as proposed by the Contractor and approved by the Engineer.

H. Vacant

I. Drilling equipment shall not be operated from an existing bridge, except as otherwise noted. If necessary and safe to do so, and if the Contractor submits a written request to the Engineer in accordance with Section 6-01.6, the Engineer may approve the operation of drilling equipment on a bridge.

J. When drilled shafts are constructed in water, the Contractor shall construct a seal between the casing shoring and the upper portion of the permanent casing for the drilled shaft as shown in the Plans, in accordance with the drilled shaft installation

plan specified in subsection 3.02.B.7 of this Special Provision, and as approved by the Engineer.

The seal thickness shown in the Plans is designed to resist the hydrostatic uplift force with the corresponding seal weight and adhesion of the seal to the permanent casing and the casing shoring of 20 psi, based on the casing shoring dimension and the seal vent water surface elevation specified in the Plans. If the Contractor uses a casing shoring diameter other than that specified in the Plans, the Contractor shall submit a revised seal design to the Engineer for approval in accordance with subsection 3.02.B.7 of this Special Provision.

If, in the opinion of the Engineer, water conditions at the time of construction allow the seal vent water surface elevation to be lowered, the Contractor may revise the casing shoring seal by submitting a revised seal design to the Engineer for approval in accordance with subsection 3.02.B.7 of this Special Provision.

K. The Contractor shall use slurry, in accordance with subsection 3.04 of this Special Provision, to maintain a stable excavation during excavation and concrete placement operations once water begins to enter the drilled shaft excavation at an infiltration rate of 12 inches of depth or more in one hour and remain present at a three inch depth or greater, except as otherwise noted. If the Contractor is utilizing casing that is adequately sealed into competent soils such that the water cannot enter the excavation, the Contractor may, with the Engineer's approval, continue excavation in wet soils provided the water level within the casing does not rise or exhibit flow.

3.04 Slurry Installation Requirements

A. Slurry Technical Assistance

1. If slurry other than water slurry is used, the manufacturer's representative, as identified to the Engineer in accordance with subsection 3.02.C of this Special Provision, shall:

   a. provide technical assistance for the use of the slurry,

   b. be at the site prior to introduction of the slurry into the first drilled hole requiring slurry, and

   c. remain at the site during the construction of the first drilled shaft excavated to adjust the slurry mix to the specific site conditions.

2. After the manufacturer's representative is no longer present at the site, the Contractor's employee trained in the use of the slurry, as identified to the Engineer in accordance with subsection 3.02.C of this Special Provision, shall be present at the site throughout the remainder of drilled shaft slurry operations for this project to perform the duties specified in items 1a through 1c above.

B. Minimum Level of Slurry in the Excavation

1. When slurry is used to maintain a stable excavation, the slurry level in the excavation shall be maintained above the groundwater level the greater of the following dimensions, except as otherwise noted in subsection 3.04.B.3 of this Special Provision:

    a. not less than ten feet for water slurries,

    b. not less than ten feet for synthetic slurries,

    c. one drilled shaft diameter,

    d. dimension as required to provide and maintain a stable hole.

    The Contractor shall provide casing, or other means, as necessary to meet these requirements.

2. The slurry level shall be maintained above all unstable zones a sufficient distance to prevent bottom heave, caving or sloughing of those zones.

3. Throughout all stops in drilled shaft excavation operations, as specified in subsection 3.03.A of this Special Provision, the Contractor shall monitor and maintain the slurry level in the excavation the greater of the following elevations:

    a. no lower than the water level elevation outside the drilled shaft,

    b. elevation as required to provide and maintain a stable hole.

C. Slurry Sampling and Testing

1. Synthetic slurry shall be mixed and thoroughly hydrated in slurry tanks, ponds, or storage areas. The Contractor shall draw sample sets from the slurry storage facility and test the samples for conformance with the appropriate specified material properties before beginning slurry placement in the drilled hole. Synthetic slurry shall conform to the quality control plan included in the drilled shaft installation plan in accordance with subsection 3.02.B.4 of this Special Provision and as approved by the Engineer. A sample set shall be composed of samples taken at mid-height and within two feet of the bottom of the storage area.

2. When synthetic slurry is used, the Contractor shall keep a written record of all additives and concentrations of the additives in the synthetic slurry. These records shall be provided to the Engineer once the slurry system has been established in the first drilled shaft on the project. The Contractor shall provide revised data to the Engineer if changes are made to the type or concentration of additives during construction.

3. The Contractor shall sample and test all slurry in the presence of the Engineer, unless otherwise directed. The date, time, names of the persons sampling and testing the slurry, and the results of the tests shall be recorded. A copy of the recorded slurry test results shall be submitted to the Engineer at the

completion of each drilled shaft, and during construction of each drilled shaft when requested by the Engineer.

4. Sample sets of all slurry, composed of samples taken at mid-height and within two feet of the bottom of the drilled shaft, shall be taken and tested during drilling as necessary to verify the control of the properties of the slurry. As a minimum, sample sets of synthetic slurry shall be taken and tested at least once every four hours after beginning its use during each shift. Sample sets of all slurry shall be taken and tested at least once every two hours if the slurry is not recirculated in the drilled hole or if the previous sample set did not have consistent specified properties. All slurry shall be recirculated, or agitated with the drilling equipment, when tests show that the sample sets do not have consistent specified properties.

5. Sample sets of all slurry, as specified, shall be taken and tested prior to final cleaning of the bottom of the hole, at least once every four hours during active placement of steel reinforcing, and again just prior to placing concrete. Cleaning of the bottom of the hole and placement of the concrete shall not start until tests show that the samples taken at mid-height and within two feet of the bottom of the hole have consistent specified properties.

D. The Contractor shall clean, recirculate, de-sand, or replace the slurry to maintain the required slurry properties.

E. The Contractor shall demonstrate to the satisfaction of the Engineer that stable conditions are being maintained. If the Engineer determines that stable conditions are not being maintained, the Contractor shall immediately take action to stabilize the drilled shaft. The Contractor shall submit a revised drilled shaft installation plan which addresses the problem and prevents future instability. The Contractor shall not continue with drilled shaft construction until the damage which has already occurred is repaired in accordance with the specifications, and until receiving the Engineer's approval of the revised drilled shaft installation plan.

G. The Contractor shall dispose of the slurry and slurry-contacted spoils as specified in the drilled shaft installation plan as approved by the Engineer, and in accordance with the following requirements:

1. Spoils in contact with water slurry may be disposed of as clean fill.

2. Synthetic slurry and water slurry with polymer-based additives shall be contained and disposed of by the Contractor at an approved facility. Spoils in contact with synthetic slurry or water slurry with polymer-based additives shall be contained and disposed of by the Contractor at an approved waste facility. Prior to beginning drilled shaft excavation operations, the Contractor shall coordinate with the waste facility operator and the Jurisdictional Health Department (JHD) to determine requirements for drilled shaft spoils disposal at the facility. The Contractor shall submit the location of the waste facility, requirements for disposal of drilled shaft spoils (as approved by the waste facility operator and the JHD), copies of any permits required and obtained, and any associated test results to the Engineer prior to disposal. The Contractor shall stockpile spoils on 6-mil

plastic and cover with 6-mil plastic to protect from runoff until approval from the waste facility operator and JHD is given to dispose of spoils.

3.05 Assembly And Placement Of Reinforcing Steel

A. The reinforcing cage shall be rigidly braced to retain its configuration during handling and construction. Individual or loose bars will not be permitted. The Contractor shall show bracing and any extra reinforcing steel required for fabrication of the cage on the shop drawings. Drilled shaft reinforcing bar cages shall be supported on a continuous surface to the extent possible. All rigging connections shall be located at primary handling bars, as identified in the reinforcing steel assembly and installation plan as approved by the Engineer. Internal bracing is required at each support and lift point.

B. The O-cell, instrumentation, supporting cables and hydraulic supply lines and other instruments shall be assembled and made ready for installation, as shown in the Plans, and in accordance with subsection 3.01.B of the SHAFT LOAD TEST Special Provision and the drilled shaft instrumentation plan as approved by the Engineer, on-site under the direction of the Loadtest representative, in a suitable area, adjacent to the test drilled shaft, to be provided by the Contractor.

C. The Engineer and the Loadtest representative shall inspect and approve test assembly prior to pick and after pick.

D. The reinforcement shall be carefully positioned and securely fastened to provide the minimum clearances listed below, and to ensure that no displacement of the reinforcing steel bars occurs during placement of the concrete. The steel reinforcing bars shall be securely held in position throughout the concrete placement operation. The Contractor shall submit details of the proposed reinforcing cage centralizers along with the shop drawings. The reinforcing steel centralizers at each longitudinal space plane shall be placed at least at the quarter points around the circumference of the steel reinforcing bar cage, and at a maximum longitudinal spacing of either 2.5 times the drilled shaft diameter or 20'-0", whichever is less.

E. Place bars as shown in the contract Plans with minimum concrete cover as shown in the table below.

Drilled Shaft Diameter	Minimum Concrete Cover
Less than or equal to 3'-0"	3"
Greater than 3'-0" and less than 5'-0"	4"
5'-0" or larger	6"

F. Drilled Shaft excavation shall not be started until the Contractor has received approval from the Engineer for the reinforcing steel centralizers required when the casing is to be pulled during concrete placement.

3.06 Access Tubes for Crosshole Sonic Log Testing

A. The Contractor shall install access tubes for crosshole sonic log testing in all drilled shafts, except as otherwise noted, to permit access for the crosshole sonic log test probes. If, in the opinion of the Engineer, the condition of the drilled shaft excavations permit drilled shaft construction in the dry, the Engineer may specify that the access tubes be omitted.

B. The Contractor shall securely attach the access tubes to the interior of the reinforcement cage of the drilled shaft. One access tube shall be furnished and installed for each foot of drilled shaft diameter, rounded to the nearest whole number, as shown in the Plans. The number of access tubes for drilled shaft diameters specified as "X feet 6 inches" shall be rounded up to the next higher whole number. The access tubes shall be placed around the shaft, inside the spiral or hoop reinforcement and bundled with the vertical reinforcement. Where circumferential components of the rebar cage bracing system prevent bundling the access tubes directly to the vertical reinforcement, the access tubes shall be placed inside the circumferential components of the rebar cage bracing system as close as possible to the nearest vertical steel reinforcement bar.

C. The access tubes shall be installed in straight alignment and as near to parallel to the vertical axis of the reinforcement cage as possible. The access tubes shall extend from the bottom of the reinforcement cage to at least two feet above the top of the drilled shaft. Splice joints in the access tubes, if required to achieve full length access tubes, shall be watertight. The Contractor shall clear the access tubes of all debris and extraneous materials before installing the access tubes. The tops of access tubes shall be de-burred. Care shall be taken to prevent damaging the access tubes during reinforcement cage installation and concrete placement operations in the drilled shaft excavation.

D. The access tubes shall be filled with potable water before concrete placement, and the top watertight PVC caps shall be reinstalled and secured in accordance with subsection 2.05.B of this Special Provision. The Contractor shall keep all of a drilled shaft's access tubes full of water through the completion of CSL testing of that drilled shaft. When temperatures below freezing are possible, the Contractor shall protect the access tubes against freezing by wrapping the exposed tubes with insulating material, adding anti-freeze to the water in the tubes, or other methods as approved by the Engineer.

E. Access tubes shall include expansion joints at O-cell locations to allow unrestrained opening and closing of the O-cells.

3.07 Placing Concrete

A. Concrete placement shall commence immediately after completion of excavation by the Contractor and inspection by the Engineer. Immediately prior to commencing concrete placement, the drilled shaft excavation and the properties of the slurry (if used) shall conform to subsections 3.03.E and 3.04, respectively, of this Special Provision. Concrete placement shall continue in one operation to the top of the drilled shaft, or as shown in the Plans and in accordance with subsection 3.03.H of the SHAFT LOAD TEST Special Provision. The Contractor shall place concrete between the upper construction joint of the drilled shaft and the top of the drilled shaft in the dry.

During concrete placement, the Contractor shall monitor, and minimize, the difference in the level of concrete inside and outside of the steel reinforcing bar cage. The Contractor shall conduct concrete placement operations to maintain the differential concrete head as 1'-0" maximum.

B. When placing concrete in the dry, only the top five feet of concrete shall be vibrated, in accordance with Section 6-02.3(9), except that the entire depth of concrete placed in the drilled shaft-column steel reinforcing bar splice zone shall be vibrated. If a temporary casing is used it shall be removed before vibration. This requirement may be waived if a temporary casing is used and removed with a vibratory hammer during the concrete placement operation. Vibration of concrete does not affect the maximum slump allowed for the concrete class specified.

C. If water is not present, the concrete shall be deposited through the center of the reinforcement cage by a method which prevents segregation of aggregates and splashing of concrete on the reinforcement cage. The concrete shall be placed such that the free-fall is vertical down the center of the drilled shaft without hitting the sides, the steel reinforcing bars, or the steel reinforcing bar cage bracing. The Standard Specification Section 6-02.3(6) restriction for 5'-0" maximum free-fall shall not apply to placement of Class 4000P concrete into a drilled shaft.

D. When placing concrete underwater, including when water in a drilled shaft excavation exceeds three inches in depth with an infiltration rate of 12 inches of depth or more in one hour, the Contractor shall place the concrete by pressure feed using a concrete pump, with a watertight tube having a minimum diameter of 4 inches. The discharge end of the tube on the concrete pump shall include a device to seal out water while the tube is first filled with concrete. Concrete placement by gravity feed is not allowed.

E. Throughout the underwater concrete placement operation, the discharge end of the tube shall remain submerged in the concrete at least 5 feet and the tube shall always contain enough concrete to prevent water from entering. The concrete placement shall be continuous until the work is completed, resulting in a seamless, uniform drilled shaft. If the concrete placement operation is interrupted, the Engineer may require the Contractor to prove by core drilling or other tests that the drilled shaft contains no voids or horizontal joints. If testing reveals voids or joints, the Contractor shall repair them or replace the drilled shaft at no expense to the Contracting Agency. Responsibility for coring costs, and calculation of time extension, shall be in accordance with subsection 3.09.H of this Special Provision.

F. Before placing any fresh concrete against concrete deposited in water or slurry, the Contractor shall remove all scum, laitance, loose gravel and sediment on the upper surface of the concrete deposited in water or slurry and chip off any high spots on the upper surface of the existing concrete that would prevent the steel reinforcing bar cage from being placed in the position required by the Plans.

Prior to performing any of the crosshole sonic log testing operations specified in subsection 3.09 of this Special Provision, the Contractor shall remove the concrete at the top of the drilled shaft down to sound concrete.

G. The Contractor's construction operation in the vicinity of a drilled shaft excavation with freshly placed concrete and curing concrete shall conform to Section 6-02.3(6)D.

H. Except for drilled shafts where the drilled shaft concrete is placed in the dry, the Contractor shall complete a uniform yield form, consistent with the sample form submitted to the Engineer as part of the drilled shaft installation plan as specified in subsection 3.02.B.6 of this Special Provision, for each drilled shaft and shall submit the completed form to the Engineer within 24 hours of completing the concrete placement in the drilled shaft.

I. Concrete shall not be placed above the top of drilled shaft (for column splice zones, columns, footings, or drilled shaft caps) until the Contractor receives the Engineer's acceptance of CSL testing, if performed at that drilled shaft, and acceptance of the drilled shaft.

3.08 Casing Removal

A. As the temporary casing is withdrawn, a minimum 5 foot head of concrete shall be maintained to balance the foundation material and water pressure at the bottom of the casing.

B. Tops of permanent casings for the drilled shafts shall be removed to the top of the drilled shaft or finished groundline, whichever is lower, unless directed otherwise by the Engineer. For those drilled shafts constructed within a permanent body of water, tops of permanent casings for drilled shafts shall be removed to the low water elevation, unless directed otherwise by the Engineer.

C. The Contractor shall completely remove all temporary casings.

3.09 Nondestructive Testing of Drilled Shafts (Crosshole Sonic Log Testing)

A. The Contractor shall provide for crosshole sonic log testing and analysis on all completed drilled shafts designated for testing by the Engineer. The testing and analysis shall be performed by the independent testing organization submitted by the Contractor and approved by the Engineer in accordance with subsection 3.02.D of this Special Provision.

The testing shall be performed after the drilled shaft concrete has cured at least 96 hours. Additional curing time prior to testing may be required if the drilled shaft concrete contains admixtures, such as set retarding admixture or water reducing admixture, added in accordance with Section 6-02.3(3). The additional curing time prior to testing required under these circumstances shall not be grounds for additional compensation or extension of time to the Contractor in accordance with Section 1-08.8.

Crosshole sonic log testing shall be conducted at all drilled shafts in which access tubes for test probe access have been installed (see subsection 3.06.A of this Special Provision).

B. After placing the drilled shaft concrete and before beginning the crosshole sonic log testing of a drilled shaft, the Contractor shall inspect the access tubes. Each

access tube that the test probe cannot pass through shall be replaced, at the Contractor's expense, with a two inch diameter hole cored through the concrete for the entire length of the drilled shaft. Unless directed otherwise by the Engineer, cored holes shall be located approximately six inches inside the reinforcement and shall not damage the drilled shaft reinforcement. Descriptions of inclusions and voids in cored holes shall be logged and a copy of the log shall be submitted to the Engineer. Findings from cored holes shall be preserved, identified as to location, and made available for inspection by the Engineer.

C. The Contractor shall submit the results and analysis of the crosshole sonic log testing for each drilled shaft tested to the Engineer for approval. The Engineer will determine final acceptance of each drilled shaft, based on the crosshole sonic log test results and analysis for the tested drilled shafts, and will provide a response to the Contractor within three working days after receiving the test results and analysis submittal.

D. Except as otherwise noted, the Contractor shall not commence subsequent drilled shaft excavations until receiving the Engineer's approval and acceptance of the first drilled shaft, based on the results and analysis of the crosshole sonic log testing for the first drilled shaft. The Contractor may commence subsequent drilled shaft excavations prior to receiving the Engineer's approval and acceptance of the first drilled shaft, provided the following condition is satisfied:

1. The Engineer approves continuing with drilled shaft construction based on the Engineer's observations of the construction of the first drilled shaft, including, but not limited to, conformance to the drilled shaft installation plan as approved by the Engineer, and the Engineer's review of Contractor's daily reports and Inspector's daily logs concerning excavation, steel reinforcing bar placement, and concrete placement.

E. If the Contractor requests, the Engineer may direct that additional testing be performed at a drilled shaft. If subsequent testing at a drilled shaft indicates the presence of a defect(s) in the drilled shaft, the testing costs and the delay costs resulting from the additional testing shall be borne by the Contractor in accordance with Section 1-05.6. If this additional testing indicates that the drilled shaft has no defect, the testing costs and the delay costs resulting from the additional testing will be paid by the Contracting Agency in accordance with Section 1-05.6, and, if the drilled shaft construction is on the critical path of the Contractor's schedule, a time extension equal to the delay created by the additional testing will be granted in accordance with Section 1-08.8.

F. For all drilled shafts determined to be unacceptable, the Contractor shall submit a plan for further investigation or remedial action to the Engineer for approval. All modifications to the dimensions of the drilled shafts, as shown in the Plans, required by the investigation and remedial action plan shall be supported by calculations and working drawings as specified in Section 6-01.9. All investigation and remedial correction procedures and designs shall be submitted to the Engineer for approval. The Contractor shall not begin repair operations until receiving the Engineer's approval of the investigation and remedial action plan.

G. If the Engineer determines that the concrete placed under slurry for a given drilled shaft is structurally inadequate, that drilled shaft will be rejected. The placement of

concrete under slurry shall be suspended until the Contractor submits to the Engineer written changes to the methods of drilled shaft construction needed to prevent future structurally inadequate drilled shafts, and receives the Engineer's written approval of the submittal.

H. At the Engineer's request, the Contractor shall drill a corehole in any questionable quality drilled shaft (as determined from crosshole sonic log testing and analysis or by observation of the Engineer) to explore the drilled shaft condition.

Prior to beginning coring, the Contractor shall submit the method and equipment used to drill and remove cores from drilled shaft concrete to the Engineer and receives the Engineer's written approval. The coring method and equipment shall provide for complete core recovery and shall minimize abrasion and erosion of the core.

If a defect is confirmed, the Contractor shall pay for all coring costs in accordance with Section 1-05.6. If no defect is encountered, the Contracting Agency will pay for all coring costs in accordance with Section 1-05.6, and, if the drilled shaft construction is on the critical path of the Contractor's schedule, compensation for the delay will be granted by an appropriate time extension in accordance with Section 1-08.8. Materials and work necessary, including engineering analysis and redesign, to effect corrections for drilled shaft defects shall be furnished to the Engineer's satisfaction at no additional cost to the Contracting Agency.

I. All access tubes and cored holes shall be dewatered and filled with grout after tests are completed. The access tubes and cored holes shall be filled using grout tubes that extend to the bottom of the tube or hole or into the grout already placed.

Measurement

4.01 Measurement

A. Measurement will be made as follows:

1. Soil excavation for drilled shaft including haul will be measured by the cubic yards of drilled shaft excavated. The cubic yards will be computed using the drilled shaft diameter shown in the Plans, the top of drilled shaft soil excavation, as defined below, and the bottom elevation shown in the Plans, unless adjusted by the Engineer, less all rock excavation measured as specified in item 2.

   Except as otherwise specified, the top of drilled shaft soil excavation shall be defined as the highest existing ground point within the drilled shaft diameter. For drilled shafts where the top of drilled shaft is above the existing ground line and where the Plans show embankment fill placed above the existing ground line to the top of drilled shaft and above, the top of drilled shaft soil excavation shall be defined as the top of drilled shaft. Excavation through embankment fill placed above the top of drilled shaft will not be included in the measurement.

2. Rock excavation for drilled shaft including haul will be measured by the cubic yards of drilled shaft excavated. The cubic yards will be computed using the drilled shaft diameter shown in the Plans, the top of the rock line, defined as

the Troutdale Formation in the Plans, and the bottom elevation shown in the Plans, unless adjusted by the Engineer.

3. Furnishing and placing temporary casing will be measured by the number of linear feet of required temporary casing, as specified in subsection 3.03.B of this Special Provision, installed within the limits shown in the Plans, plus additional length approved by the Engineer for temporary casing required to address field conditions as encountered.

4. Furnishing permanent casing will be measured by the number of linear feet of required permanent casing, as specified in subsection 3.03.B of this Special Provision, installed below the cutoff elevation.

5. Placing permanent casing will be measured by the number of permanent casings placed.

6. Casing shoring will be measured by the number of linear feet of casing shoring installed. The linear feet dimension will be computed using either the top of ground line, defined as the highest ground line elevation within the casing shoring, or the specified drilled shaft seal vent elevation as shown in the Plans, whichever is higher, and the bottom elevation as shown in the Plans.

7. Concrete Class 4000P for drilled shaft will be measured by the cubic yards of concrete in place. The cubic yards will be computed using the drilled shaft diameter shown in the Plans, and the top and bottom elevations shown in the Plans, unless adjusted by the Engineer.

8. Steel reinforcing bar for drilled shaft will be measured by the computed weight of all reinforcing steel in place, as shown in the Plans. Bracing for steel reinforcing bar cages shall be considered incidental to this item of work.

9. CSL access tube will be measured by the linear foot of tube furnished and installed including expansion joints.

10. CSL test will be measured once per drilled shaft tested.

Payment

5.01 Payment

A. Payment will be made, in accordance with Section 1-04.1, for the following bid items when they are included in the proposal:

1. "Soil Excavation For Shaft Including Haul", per cubic yard, including all costs in connection with furnishing, mixing, placing, maintaining, containing, collecting, and disposing of all synthetic, and water slurry, and disposing of ground water collected by the drilled shaft excavation. No additional payment will be made for subsequent or repeated SID inspections of the same drilled shaft excavation. No claims for either lost time or actual expense of any SID inspections will be paid.

2. "Rock Excavation For Shaft Including Haul", per cubic yard.

3. "Furnishing & Placing Temp. Casing For _____ Dia. Shaft", per linear foot, including all costs in connection with completely removing the casing after completing drilled shaft construction.

4. "Furnishing Permanent Casing For ____ Diam. Shaft", per linear foot.

5. "Placing Permanent Casing For _____ Diam. Shaft", per each.

6. "Casing Shoring", per linear foot, including all costs in connection with removing the casing shoring and placing seals when required.

7. "Shoring Or Extra Excavation Cl. A - _____", lump sum, including all costs in connection with all excavation outside the limits specified for items 1 and 2, all temporary telescoping casings, and all temporary casings not included in the measurement for required temporary casing in accordance with subsection 4.01.A.3 as specified in this Special Provision.

8. "Conc. Class 4000P For Shaft", per cubic yard.

9. "St. Reinf. Bar For Shaft", per pound, including all costs in connection with furnishing and installing steel reinforcing bar centralizers.

10. "CSL Access Tube", per linear foot including all costs for expansion joints.

11. "CSL Test", per each drilled shaft tested.

12. "Removing Shaft Obstructions", estimated.

B. Payment for Removing Drilled Shaft Obstructions

1. Payment for removing, breaking-up, or pushing aside, drilled shaft obstructions, as defined in subsection 3.03.G of this Special Provision, will be made for the changes in drilled shaft construction methods necessary to deal with the obstruction. The Contractor and the Engineer shall evaluate the effort made and reach agreement on the equipment and employees utilized, and the number of hours involved for each. Once these cost items and their duration have been agreed upon, the payment amount will be determined using the rate and markup methods specified in Section 1-09.6. For the purpose of providing a common proposal for all bidders, the Contracting Agency has entered an amount for the item "Removing Shaft Obstructions" in the bid proposal to become a part of the total bid by the Contractor.

2. If drilled shaft construction equipment is idled as a result of the work required to deal with the obstruction and cannot be reasonably reassigned within the project, then standby payment for the idled equipment will be added to the payment calculations. If labor is idled as a result of the work required to deal with the obstruction and cannot be reasonably reassigned within the project, than all labor costs resulting from Contractor labor agreements and established Contractor policies will be added to the payment calculations.

3. The Contractor shall perform the amount of obstruction work estimated by the Contracting Agency within the original time of the contract. The Engineer will consider a time adjustment and additional compensation for costs related to the extended duration of the drilled shaft construction operations, provided:

   a. the dollar amount estimated by the Contracting Agency has been exceeded, and

   b. the Contractor shows that the obstruction removal work represents a delay to the completion of the project based on the current progress schedule provided in accordance with Section 1-08.3.

DIVISION 8
MISCELLANEOUS CONSTRUCTION

(******)
PILE REMOVAL AND CLEANUP

Construction Requirements
Following completion of load testing and test pile inspections, the Contractor shall remove and dispose of or salvage items as listed below. The Contractor shall dispose of all items in accordance with Section 2-02.3.

The Contractor shall remove all 24-inch diameter steel pipe piles installed in this project.

Submittal
The Contractor shall submit to the Engineer for approval a Demolition Plan with working drawings and a Safety Plan five working days prior to pile removal. The Demolition Plan shall demonstrate that the methods and equipment to be used are adequate for the intended purpose and will provide satisfactory results.

Steel Pile Removal
Piles shall be removed with a force that is coaxial with the vertical axis of the pile. Remaining pile voids shall be filled with Controlled Density Fill (CDF). Piles shall be removed one at a time. Concurrent multiple pile removal is not allowed. The steel pile shall be cut off 5 feet below the existing ground surface, and filled with CDF and topsoil, if it cannot be removed by methods in the approved Demolition Plan.

Measurement
No specific unit of measurement will apply to the lump sum item of "Pile Removal and Cleanup."

Payment
Payment will be made in accordance with Section 1-04.1, for the following bid item:

"Pile Removal and Cleanup", lump sum.
The lump sum contract price for "Pile Removal and Cleanup" shall be full pay for performing the work as specified.

EROSION CONTROL AND WATER POLLUTION CONTROL

ATTACHMENT C

Progression of Work

Damaged BS-1 Casing

From Slide 25 of State's final PowerPoint presentation

Washington State Department of Transportation